INSERT, HOLDER AND CUTTING TOOL

BACKGROUND OF THE INVENTION

The present invention relates to an insert, a holder and a cutting tool.

Conventionally, there is a cutting tool 104 in which an insert 102 having a basic form of parallelogram is detachably mounted by a clamp screw 103 as clamping member on a tip mounting face 101 of a holder 100. The holder 100 of this cutting tool 104 has the flat tip mounting face 101 provided with a female thread hole 105 into which the clamp screw 103 is screwed, and a restricting wall 106 for restricting the movement of the insert 102 by taking two sides of the insert 102 which is protruded on the tip mounting face 101. Such cutting tool 104 is mainly employed for cutting-off, grooving, cutting with a saw, and thread cutting work, in which a force applied on the insert 102 at the time of cutting is supported on the restricting wall 106 of the holder 100.

Usually, the insert 102 having a basic form of parallelogram is provided with the cutting edges 102a in two corner portions of acute angle that are located in point symmetry around the clamp screw 103, and when one cutting edge 102a is worn, the other cutting edge 102a is used by rotating the insert 102. Further, the cutting edge 102 rotated on the backside makes contact with the restricting wall 106 of the holder 100

to restrict the movement of the insert 102.

By the way, the cutting edge 102a of the insert 102 may be broken during the cutting work. Particularly, because the insert 102 for cutting-off or grooving work has a thinner cutting edge portion, as shown in Fig. 8, most of the cutting edge 102a may be possibly broken away. When rotated on the backside, the cutting edge 102a has an important role of making contact with the restricting wall 106 of the holder 100 to restrict the movement of the insert 102. Thereby, if that portion is missed, the restricting force of the insert 102 is weakened, and the cutting tool may possibly become unusable.

SUMMARY OF THE INVENTION

This invention is achieved in the light of the above-mentioned problems, and it is an object of the invention to provide an insert, a holder and a cutting tool in which even if one cutting edge portion is missed, the use of another cutting edge is allowed.

The invention of aspect 1 provides an insert having a basic form of parallelogram or rectangle that is detachably mounted by clamping member on a tip mounting face of a holder, characterized in that two or more concave grooves are formed like parallel stripes on the tip mounting face of the holder, and two or more convex lines are formed on its own abdominal face to be fitted in the concave grooves, in which the insert

is clamped by the clamping member in a state where its own convex lines are fitted in the concave grooves on the tip mounting face, the clamping member as a screw clamp structure fixes the insert by tightening a clamp screw through its own screw insertion hole into a female thread hole on the tip mounting face, and a convex line missing part is provided in a region including the periphery of an opening edge of the screw insertion hole and opposed to the tip mounting face of the holder, in which the tip mounting face and the convex line missing part are out of contact at least before tightening the clamp screw.

Further, the invention of aspect 7 provides a holder for holding an insert that is detachably mounted by clamping member on its own tip mounting face, characterized in that two or more concave grooves are formed like parallel stripes on an abdominal face of the insert, and two or more convex lines are formed on its own tip mounting face to be fitted in the concave grooves, in which the insert is clamped by the clamping member in a state where the concave grooves of the insert are fitted in the convex lines on the tip mounting face, the clamping member as a screw clamp structure fixes the insert by tightening a clamp screw through a screw insertion hole of the insert into a female thread hole on its own tip mounting face, and a convex line missing part is provided in a region including the periphery of an opening edge of the screw insertion hole and opposed to the insert, in which the insert and the convex line missing part are out

of contact at least before tightening the clamp screw.

Because the tip mounting face of the holder and the abdominal face of the insert are securely integrated by engagement between a plurality of concave grooves and convex lines, the restricting wall indispensable with the conventional holder is dispensed with. Accordingly, even if one cutting edge of the insert is broken away, another cutting edge is usable without being affected.

Further, in working the screw insertion hole or the female thread hole, the periphery of the opening edge of hole may be swollen and deformed in some cases, in which the convex line missing part is provided in that portion to prevent the tip mounting face and the insert from being connected, thereby enhancing the mounting precision of the insert.

The convex lines and the concave grooves are an integral concept of representing the mating relation, in which a concave groove is located between each of the convex lines and a convex line is located between each of the concave grooves. Accordingly, the convex lines and the concave grooves, which are mated with each other, make almost the same operation, and are appropriately used for the sake of convenience in this invention.

The concave grooves or convex lines is optimally from three to five as defined in aspects 2 and 8, deducing the functional size of concave grooves or convex lines from the

standard area of the tip mounting face.

Further, a step portion is formed on the abdominal face of the insert in a direction crossing the convex lines or concave grooves, the step portion being engaged in the engagement step portion provided on the holder, as defined in aspects 4 and 10, whereby the insert is completely restricted only by mating the abdominal face of the insert and the tip mounting face of the holder.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a cutting tool.

Fig. 2 is a perspective view of the cutting tool.

Fig. 3 is a plan view of an essential part of the cutting tool.

Fig. 4A is a cross-sectional view taken along the line X-X of Fig. 3, and Fig. 4B is a partially enlarged view of Fig. 4A.

Fig. 5A is a transversal plan view showing an essential part of the cutting tool and Fig. 5B is a partially enlarged view of Fig. 5A.

Fig. 6 is a perspective view of an insert.

Fig. 7 is an exploded perspective view of the cutting tool.

Fig. 8 is an exploded perspective view showing the conventional art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

Referring to Figs. 1 to 6, an embodiment 1 of the present invention will be described below. Fig. 1 is an exploded perspective view of a cutting tool, Fig. 2 is a perspective view of the cutting tool, Fig. 3 is a plan view of an essential part of the cutting tool, Fig. 4A is a cross-sectional view taken along line X-X of Fig. 3, Fig. 4B is a partially enlarged view of Fig. 4A, Fig. 5A is a transversal plan view showing an essential part of the cutting tool, Fig. 5B is a partially enlarged view of Fig. 5A, and Fig. 6 is a perspective view of an insert.

The cutting tool 1 is composed of three components, a holder 2, an insert 3 and a clamp screw 4 as clamping member, as shown in Fig. 1. The holder 2 has a tip mounting area in a top portion lowered by one step, in which a top end portion further lowered by one step in the tip mounting area is a tip mounting face 2a. On this tip mounting face 2a, four concave grooves 6 like a V-character in section are formed in parallel and at an equal pitch to make the stripes, in which a female thread hole 2b engaged by the clamp screw 4 is formed in the center of a group of concave grooves 6 in the length and height directions (i.e., center of the tip mounting face 2a). Further, the tip mounting face 2a is located at the top end portion lowered

by one step in the tip mounting area, in which a boundary portion with a step difference is an engagement step portion 2c crossing at right angles to the concave grooves 6. This engagement step portion 2c is an inclined face. Between adjacent concave grooves 6, 6 is a convex line 70 like a ridge in section and having a chamfered portion 80 at the top portion.

On the other hand, the insert 3 has a basic form of parallelogram, in which a screw insertion hole 3a for inserting the clamp screw 4 is provided in the center of parallelogram, and two cutting edges 3b with smaller thickness are provided at two corner portions of acute angle that are located in point symmetry around the screw insertion hole 3a. Further, a dimple groove 3c for cutting work is formed on a knife-edge rake face at the top end of the cutting edge 3b. On an abdominal face of the insert 3 (a face contact with the tip mounting face 2a of the holder 2), four convex lines 7 like a ridge in section to be fitted into the concave grooves 6 of the tip mounting face 2a and having a chamfered portion 8 at the top end are protruded in parallel and at an equal pitch, and a step portion 3d engaging the engagement step portion 2c of the holder 2 is formed at both end portions of the convex lines 7. Between adjacent convex lines 7, 7 is a concave groove 60 like a V-character in section.

However, on the abdominal face of the insert 3, a flat convex line missing part is provided in a region including the

periphery of an opening edge of the screw insertion hole 3a and opposed to the tip mounting face 2a of the holder 2. The convex line missing part 9 as shown is flush with a root of the concave grooves 60. The convex line missing part 9 is worked to be flat, but when the screw insertion hole 3a is punched, a slightly swollen deformation portion 10 is produced in a peripheral portion (see a slanting line portion in Fig. 6) of the opening edge of the screw insertion hole 3a, as shown in Figs. 4B and 5B. The swollen deformation portion 10 as shown in Figs. 4B and 5B is exaggerated to make the understandings easier, and the actual swollen deformation portion 10 is 0.05mm or less thick with a tip thickness of 6.5mm. If the convex lines 70 on the tip mounting face 2a of the holder 2 abuts against this swollen deformation portion 10, the mounting precision of the insert 3 is degraded, whereby a clearance α between the top portion of the convex lines 70 (chamfered portion 80) and the convex line missing part 9 is set to be slightly larger to surpass a deformation amount of the swollen deformation portion 10. The set value of clearance α may be decided in consideration of various conditions, including the tip thickness, tip material, and the boring method, but actually may be in a range from 0.05mm to 0.5mm to deal with most of the cases. In this connection, the clearance α is set at 0.1mm with a tip thickness of 6.5mm in the embodiment 1.

A procedure for assembling the cutting tool 1 of the

invention will be described below. First of all, the convex lines 7 of the insert 3 are fitted into the concave grooves 6 of the tip mounting face 2a, and the step portion 3d of the insert 3 is engaged in the engagement step portion 2c of the tip mounting face 2a. In this state, the tip mounting face 2a of the holder 2 and the abdominal face of the insert 3 are mated with each other, and the tip mounting face 2a of the holder 2 traverses over the convex line missing part 9 of the insert 3. However, even if the tip mounting face 2a of the holder 2 transverses over the convex line missing part 9 of the insert 3, the convex line missing part 9 has no convex lines, and there is the clearance α surpassing the deformation amount of the swollen deformation portion 10 between the convex line missing part 9 and the tip mounting face 2a (the top portion of the convex lines 70), whereby there is no fear that both are contacted. Accordingly, the insert 3 is stabilized on the tip mounting face 2a of the holder 2.

In this state, the insert 3 is tightened by the clamp screw 4 through the screw insertion hole 3a of the insert 3. By tightening this clamp screw 4, the tip mounting face 2a of the holder 2 and the abdominal face of the insert 3 are integrated firmly by engagement between the concave grooves 6 and the convex lines 7, whereby it is unnecessary to have the conventional restricting wall 106 of the holder 2. As will be clear from a cross sectional view of Fig. 5A, the cutting edge 3b on the

rear side of the insert 3 is out of contact with the holder 2.

And if one cutting edge 3b is naturally exhausted or broken, the clamp screw 4 is removed, the insert 3 is rotated, and the clamp screw is tightened again. As will be apparent from the above description of this invention, the insert 3 is fully restricted by engagement between the abdominal face of the insert 3 and the tip mounting face 2a, and the cutting edge 3b is not the component for restricting the insert 3, whereby even if the cutting edge 3b is broken, the insert 3 is fully restricted.

A performance test of the cutting tool 1 of this invention is conducted. The insert 3 as shown is produced by setting the cutting edge width to 3mm, the knife edge lead angle to 0°, and the knife edge corner R to 0.05mm, and mounted on the holder 2 as shown. Further, a round bar made of material SCM 415 and having a diameter of 20mm is revolved at 2000rpm, and a cutting-off work is performed by the cutting tool 1. The feed per revolution is set to F0.03, F0.06, F0.08 and F0.10 to check the cutting condition, in which the cutting-off work can be performed in all the cases without problem. It is confirmed that the chips are rolled by the dimple groove 3c for cutting work provided on the knife edge rake face of the insert 3, namely, the dimple groove 3c effectively acted as a measure for preventing the work from being damaged due to chips.

(Embodiment 2)

Referring now to Fig. 7, an embodiment 2 of the invention will be described below. Fig. 7 is an exploded perspective view of the cutting tool.

In this embodiment 2, a convex line missing part 90 is provided in a region including the periphery of the opening edge of the female thread hole 2b on the tip mounting face 2a of the holder 2 and opposed to the insert 3. In this case, because the swollen deformation portion 10 is produced in the opening edge of the screw insertion hole 3a of the insert 3, the bevels of the convex lines 7 are partially swollen. However, there is no factor for decreasing the mounting precision of the insert 3, since the deformation portion corresponds to the convex line missing part 90 of the holder 2.

This invention is described above, but is not limited to those described embodiments. For example, in the embodiments, the concave grooves 6 are formed on the tip mounting face 2a, and the convex lines 7 are formed on the abdominal face of the insert 3. However, the convex lines 70 may be formed on the tip mounting face 2a and the concave grooves 60 may be formed on the abdominal face of the insert 3, as already described.

Further, the concave grooves 6 of the embodiments are shaped like a V-character in section, but may be semi-circular or rectangular in section. The same is true with the convex lines 7, because the shape of the convex lines corresponds to

the shape of the concave grooves 6. Though being not particularly limited, the number of concave grooves 6 (convex lines 7) is optimally from three to five, deducing the functional size of concave grooves 6 from the standard area of the tip mounting face 2a.

The insert 3 of the embodiments has a basic form of parallelogram, but may have a basic form of rectangle. In this invention, the insert 3 is fully restricted only by engagement between the abdominal face of the insert 3 and the tip mounting face 2a, whereby the insert 3 having the basic form of parallelogram and the insert 3 having the basic form of rectangle may be appropriately used in one holder 2.

Further, in the embodiments, the clamping member has a screw clamp structure, but may be a well-known clamp (not shown) of the so-called clamp-on in which the insert 3 is clamped on the tip mounting face 2a. Though the cutting-off work is only performed in the performance test, the grooving, cutting with a saw, and thread cutting work may be also effectively performed with the excellent performance.

By the way, though the concave grooves 6, 60 and the convex lines 7, 70 are described separately in the embodiments, the concave grooves 6, 60 and the concave grooves 6, 60 may be connected and the convex lines 7, 70 and the convex lines 7, 70 may be connected to constitute a serration groove of the almost same specification. Hence, this invention may be grasped

such as "the insert, holder and cutting tool in which the serration groove of the same specification is formed on the tip mounting face of the holder and the abdominal face of the insert, and the insert is fixed by the clamping member in the state where the serration grooves mated together." In this case, the concave grooves and the convex lines in the embodiments may be replaced with the serration groove. Further, if a clearance is provided between the chamfered top portion of crest of the serration groove and the root, the taper faces of the serration groove may be securely contacted by tightening the clamp screw 4, remarkably increasing the mounting precision of the insert 3.

With the invention, because the tip mounting face of the holder and the abdominal face of the insert are securely integrated by engagement between a plurality f concave grooves and convex lines, the restricting wall of the holder is dispensed with. Accordingly, even if one cutting edge of the insert is broken away, another cutting edge is usable without being affected. As a result of dispensing with the restricting wall of the holder, the height of the tip mounting face can be consistent with the height of the insert, whereby the cutting tool is slimmed. Further, in working the screw insertion hole or the female thread hole, the periphery of the opening edge of hole may be swollen and deformed in some cases, in which the convex line missing part is provided in that portion to

prevent the tip mounting face and the insert from being connected, thereby enhancing the mounting precision of the insert.

Further, if the clamping member has a screw clamp structure of one clamp screw, the insert is promptly mounted or detached.